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Peer Review Report

Peer review report 1 On "A GIS-based approach for supporting groundwater protection in eskers: application to sand and gravel extraction activities in Abitibi-Temiscamingue, Quebec, Canada"

1. Original Submission

1.1. Recommendation

Major Revision

2. Comments to Author:

Eskers are locally important aquifers in several areas with historical glacial activity around the world. The management of eskers should be emphasized and for that purpose new methods should be presented. The method developed in this study is simple: for decision makers the results should be kept simple for them to understand the results without background in hydrogeology. Therefore the simple solution is good for management but one has to be careful what these simplifications mean. Also, the method presented in this study is highly similar to spatial multicriteria decision analysis and the presented method should be compared/connected to this method. The structure of the manuscript and the classification method should also be reconsidered. These are the major concerns of the study.

First, the spatial multicriteria decision analysis method is a management method where value functions are formed for ideal areal solutions. This is similar to ideas in this article and the presented here can be connected/reflected on to the vast scientific literature of this spatial management method.

Second, the hydrological, geological and other simplifications are expected downsides for large scale spatial analysis. Authors have discussed these simplifications, but there are issues that could be more accurately explained. First, you have used the seepage areas and springs to define 'aquifer potential level' with 2000 m circle. The circle doesn't consider which direction the water is coming from the esker (or both which is also possible). As you've defined esker reference surfaces you could use the tilting of these surfaces for more accurate direction of groundwater flow to the spring/seepage. It could be checked if the tilting would bring more information.

Then, you've compared your reference surface elevation to the measured groundwater tables. Why the authors haven't shown where these measurement points are spatially by adding them to one of the map figures of the area? This would give an idea e.g. if the clay belt border would have an impact to water levels.

Also concerning simplifications, authors should present how they ended up with 500 m distance from bedrock as a relevant distance to lower APL, same goes for spring/seepage 2000 m ring. This is merely explained by citation to Nadeau (2011), but as this is a fundamental part of this study, this should be better presented.

Third, the structure of the manuscript is rather mixed. Authors present methods in the methods-section then show results of these methods and then continue with new method based on the previous one and explain this method and its results in the discussion section. The method presented and formed should be in the method-results-section and discussion should discuss about the results, how the method performed and mirror the method results to previous literature.

Concerning the classification method, Extraction pressure index presented from line 305 onward doesn't open for a reader easily. As the term 1 is for 500 m radius and term 2 for 1000 m radius, the interpretation of the map from a quick look made by a decision maker is hard. The names "term 1" and "term 2" don't tell anything to the reader and the map doesn't explain

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itself to the reader without more thorough reading of the method. Also, smaller example map from selected area would help to understand the results (see individual remarks).

For the GDEs an example map also would reveal what you're discussing in the chapter 5.3.2. What does a risk-area GDE spring/seepage look like? What does the gravel exctraction mean near a GDE look like. A cross section from the elevation data where risks are high for example would nicely show how the exctraction has impacted DRASTIC-attributes and therefore would show the benefit of your method.

2.1. Individual remarks

The figures have some issues. The results are small-scaled and partly disappear into the large map area. A selected example area would be good to show how the results look in a selected esker/part of an esker. Val-d'Or area might be a good example. Also, at least this selected example area should show how wells, springs/seepages and extraction sites are placed as it would give a bit better idea how these land use and GDE-areas collide in worst case. Even though the concepts are presented in Figs 4 and 9, this addition to result maps would help to understand the deviation of results in the larger scale of the map.

Concerning Figure 2, shouldn't there be a citation in figure text where this theory is presented as the theory is not in this article.

As there is a lot of abbreviations in the articles as the names of different indices (GSC, RSD, APL, MGD, GRSI, EPI, Term 1, Term 2), the figure texts are hard to read to understand what is going on. For example Fig 7 text first discusses RSD and then explains the abbreviation second time. The figures and the figure texts should be self-explanatory as possible. Now understanding of figures is complicated.

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